GAMMA-RAY PULSE TUBE COOLER DEVELOPMENT AND TESTING

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For a variety of space-science applications, such as gamma-ray spectroscopy, the introduction of cryogenic cooling via a cryocooler can greatly increase the potential science return by allowing the use of more sensitive and lower noise detectors. At the same time, the performance benefits must be carefully weighed against the implementation cost, any possibility of increased detector noise associated with the operation of the cryocooler, and the requirement to achieve long life. This paper describes the development, test, and performance of a novel new low-cost, low-noise, high-reliability pulse tube cooler, designed specifically for highly cost-constrained long-life space missions.

The developed cooler marries two technologies: a low-cost high-reliability linear compressor and drive electronics from the 1.75 W tactical Stirling cryocooler of DRS Infrared Technologies (formerly Texas Instruments), and an 80 K pulse tube developed specifically for the compressor by Lockheed Martin ATC. The successful new cooler achieves over 1.5 watts of cooling at 80 K at 22 W/W, and has the advantage of greatly reduced vibration at the cold-tip and no life-limiting moving cold elements.

To achieve maximum life and low vibration, the compressor incorporates flat flexure springs for piston support and uses two opposing pistons in a head-to-head configuration with linear drive motors. The pulse tube is a compact U-tube configuration for improved integration and is mounted to the compressor in a split configuration with a transfer line.

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